Low-rank traffic matrix completion with marginal information

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Abstract: Accurate spatio-temporal traffic data is crucial to intelligent transportation systems. Missing traffic data is an important problem to solve. Low-rank matrix completion provides an effective way to find the missing data. The completion aims to obtain a low-rank matrix that can approximate the known entries as far as possible. Meanwhile, some linear constraint marginal information of the matrix can also be observed in the real application. In this paper, we utilize such marginal information to largely improve the performance of common matrix completion algorithms and propose an alternating direction method of multipliers (ADMM) and conjugate gradient descent method (CGD) based SoftImpute alternative least square (ALS) algorithm. We analyze their convergence rates and prove that the model can always converge to a first-order stationary point. We also utilize ADMM and CGD to largely accelerate the subproblem and make its complexity of each iteration at the same level as the popular SoftImpute-ALS matrix completion algorithm. Furthermore, this algorithm can be used in distributed computation, suitable for large-scale problems. In the numerical experiments, we demonstrate its outstanding matrix completion performance and high speed in several traffic matrix datasets.